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ABSTRACT

The Continuity Project is a research, development, and technology transfer initiative aimed at creating a "Library of the Future" by combining features of an online public access catalog (OPAC) and a campus wide information system (CWIS) with advanced facilities drawn from such areas as artificial intelligence (AI), knowledge representation (KR), natural language processing (NLP), computer applications and software engineering (CASE), literate programming, hypertext research, and computer supported cooperative work (CSCW). By taking this approach, Continuity will be able to provide an intelligent, unified, and proactive information infrastructure for the learning organization of the future. The explosive growth rate of the body of accumulated knowledge and increasingly powerful information technology and computing tools have exceeded the capabilities of traditional approaches to cataloging and collection management. In the new millennium, the ability to find and integrate relevant existing knowledge is the new limiting factor on the rate of scientific and commercial innovation. This report describes the Continuity Project and contains the following sections: Project Overview; Project Update; Project's Inspiration; Philosophy Behind the Project; Need and Prospects for the Project; Desiderata; Scenario--illustrating system capabilities; Simulated User Session; We Can Build It; Director-- personal description; Project Advisory Board; Managing the Project; Common Concerns--questions and answers; Project on the Web--description of further information on the Web; and the project director's resume. (SWC)

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ED 414 913

Continuity

It is time to reconceptualize the role of the library and refashion the on-line catalog into an intelligent proactive medium for the social construction of knowledge.

Strategic Planning...

The Continuity Project
Fall 1997 Report

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Continuity An Extensible Intelligent Integrated Collaborative Catalog & Distributed Institutional Memory Archive

Project Overview

Welcome to The Continuity Project!

The Continuity Project is a new research, development, and technology transfer initiative aimed at creating a *Library of the Future* by combining features of an on-line public access catalog (OPAC) and a campus wide information system (CWIS) with advanced facilities drawn from such areas as artificial intelligence (AI), knowledge representation, (KR), natural language processing (NLP), computer applications and software engineering (CASE), literate programming, hypertext research, and computer supported cooperative work (CSCW). By taking this approach, Continuity will be able to provide an intelligent, unified, proactive, information infrastructure for the learning organization of the future.

The Genesis of the Need for Continuity

Such systems were first envisioned as far back as the 1930's when the first hints of information overload were beginning to appear on the horizon. Since then, the body of accumulated knowledge held in our collections has grown at a truly explosive rate with disciplines spawning sub-disciplines far to rapidly for even the finest research libraries to keep pace. Moreover, this growth of total knowledge is locked in an accelerating feedback loop with the development of increasing powerful information technology and computing tools Our traditional approaches to cataloging and collection management were never designed to cope with these dynamics.

Thus as the new millennium approaches, the ability to **find and integrate relevant existing knowledge**, rather than the need to make discoveries *de novo*, is emerging as a new limiting factor on the rate of scientific and commercial innovation. Indeed, even the most basic of original pure research is often predicated on just such an understanding of its antecedents.

Since this ability to innovate and facilitate innovation is, and will no doubt remain, the primary source of competitive advantage at the firm, regional, and national level, the importance of creating such advanced active information infrastructures can not be stressed too highly.

Rational for the Project

Indeed, the creation of tools to augment our cognitive abilities goes to the very heart of the Technopolis Strategy[1] of promoting advanced technology for economic development. Since we now find ourselves enmeshed in a new global economy in which, for the most part, we can't afford to compete in commodotized areas, our best hope to maintain a high standard of living is to become more efficient at research, innovation, and technology transfer at the cutting edge. By staking out this high ground, we can command high enough margins for the fruits of our labor to maintain and expand our lead well into the next century.

But to do so, we must work smarter, and that means we must learn to get the most leverage from what we know and find more effective ways to collaborate with one another in the pursuit of new knowledge and products.

No area offers greater potential leverage in this regard than an effort to integrate use of the library catalog and campus wide information system into an ubiquitous knowledge-based infrastructure that goes far beyond the traditional OPAC to directly model the people and their research embodied in the collection and working in the community.

Continuity

Thus Continuity would serve as a virtual Wagon Wheel[2] bringing together people, ideas, and resources to establish a much more intimate *continuity* between the sources of written knowledge and their uses, between authors and readers, between researchers and practitioners, between librarians and patrons, between students past and present, and between the university and its community.

Without ***continuity***, we are far too dependent on ***serendipity***.

Its just too much work to find new people, ideas, projects, and resources using our current tools. The catalog lacks the depth of coverage, the campus web lacks the organization and automated access, and our would be collaborators (be they on or in the community) lack the time to sift through it all.

With your help, Continuity will change all that.

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[1] See *The Technopolis Phenomenon : Smart Cities, Fast Systems, Global Networks* Edited by David V. Gibson, George Kozmetsky, and Raymond W. Smilor. Rowman & Littlefield Publishers, Inc, 1992.

[2] The Wagon Wheel bar in Mountain View has been credited as the key catalyst for many of Silicon Valley's semiconductor industry collaborations. See *Regional Advantage : Culture and Competition in Silicon Valley and Route 128* by Annalee Saxenian. Harvard, 1994.

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Project Update

Its been a busy and productive summer with the Continuity Project making visits to the American Association for Artificial Intelligence Fourteenth National Conference on Artificial Intelligence in Providence, Rhode Island; MacWorld in Boston; JavaWorld and later ITForum in New York City; and several university campuses.

Our library continues to grow with the addition of new tiles and resources in artificial intelligence, computer science, computational linguistics, information studies, innovation management, programming language design, and technology transfer.

Dr. Susan Thomas and Steven J. McCaffrey have joined the Continuity Advisory Board.

I have recently completed a major update and reorganization of our project website[3] adding navigational graphics and abstracting out common page elements through the use of *server side includes* directives which will make it dramatically easier to execute future revisions. I have also made liberal use of server *redirection* to avoid breaking any existing links pointing into our site. Finally I am incorporating *meta* tags into the site to insure optimal indexing and abstracting by automatic search engines.

For the first time, we have made design mock ups of our user interface development efforts available as *design notes*[4] in which you will find a number of simulated screen shots that capture the flavor of what it will be like to work with a Continuity terminal.

As a result, the web site itself has generated considerable interest, putting us into contact with several colleagues in such places as France and Norway, who have written to us to request additional information and to share the fruits of their research. Our server logs indicate a slow but steady growth in the popularity of our site with hits arriving from as far away as Japan and Australia, showing a fairly even split between academic and industry domains with a slight bias towards the former.

We plan several major enhancements to the web site during the fall semester. First we are going to augment the site with a Meta Content Format (MCF) description of our offerings, which will enable Windows and Macintosh users who download the free HotSauce plug-in for Explorer and Navigator to experience a 3-D flythrough of our site hierarchy and the conceptual relationships within it. We will be using Eastgate Systems Web Squirrel to generate the MCF and to begin to catalog the many on-line resources with which we have been working.

As to substance, we plan to add *syllabi*, *course notes*, and *lecture notes* in preparation for meeting the teaching responsibilities and opportunities to engage undergraduate and graduate students in the work of the project when we find a host institution. In the meantime we hope that the materials themselves will be of value to our many colleagues whose current course offerings touch on the issues we are addressing.

In terms of our own research and development initiatives, we have made the first in a series of *tech notes*[5] available with a description of Epoch the homoiconic multiparadigm literate end-user programming language & extension framework that we are developing for Continuity.

Of course we recognize that no one institution will have the resources to fully develop Continuity independently, which is why I am establishing and coordinating the new *Stone Soup*[6] clearinghouse for research on *Component Integration and Distribution in the Development of New Millennium OPACs* at the *CyberStacks*[7]. This clearinghouse will encourage researchers developing elements of next generation systems to leverage their work off existing tools and to make their own efforts more widely available. It is also hoped that clearinghouse participants will join in producing an anthology that could be used as a supplemental reading at the graduate level.

By drawing on the work cataloged in the Stone Soup clearinghouse, The Continuity Project will be able to make the truly optimal use of existing technologies, placing it in a preeminent position to serve as the nucleus of a possible new catalog consortium.[8]

All we would then need to create a unified *collaborative catalog & campus wide information system* would be a strategic partnering with a network computer (NC) vendor to create the physical infrastructure of low cost terminals.

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[3] <http://www.cloud9.net/~futurist/continuity>

[4] <http://www.cloud9.net/~futurist/continuity/design_notes/>

[5] <http://www.cloud9.net/~futurist.continuity/tech_notes/>

[6] <http://www.public.iastate.edu/~CYBERSTACKS/StoneSoup.htm>

[7] <http://www.public.iastate.edu/~CYBERSTACKS/>

[8] For a most enlightening treatment of such initiatives see *R&D Collaboration on Trial : The story of MCC -- America's first major, for-profit R&D consortium -- and its quest to enhance the competitiveness of American high-tech firms* by David V. Gibson and Everett M. Rogers. Harvard Business School Press, 1994.

The Project's Inspiration

We are not the first to look beyond the library of today and in the often quoted words of Isaac Newton, if we "have seen further it is by standing on ye shoulders of Giants". Let us pause then and consider the futures that might have been:

Yet even the expert today has often to ignore past work in his field because of the labor of getting at it; because of the inescapable preliminary drudgery he may be deterred from tackling even a problem which he is especially qualified to attack, thinking it better to put his skills on other tasks. ...

The pressing of a button should place immediately on the desk not merely one book or one article, but every appropriate item which the individual has collected, every thought or theory which he had formed or recorded, plus all those data which cooperative judgment had shown to be useful in attacking the problem under consideration. ...

...the device will implement cooperation and aid in giving to the "fellowship of learning" the instrumentality which is implied in that term.

Professor Jones is a spectroscopist... He has an article in the Physical Review before him and, not once but several times in the course of this article, he writes mysterious words in the margin. ... In the course of an evening he makes 30 or 40 such entries. ... He tosses the journals he has reviewed into a basket marked "library", and forgets them. After a day or two the journals appear back on his desk stamped "entered".

:Six months later he meets a student named Smith in the corridor. Smith has got to the point in his research where he wishes to examine the spectrum of doubly ionized lithium; so he asks the professor what is the best method of obtaining it. "Read the literature on the subject for the last year, and we will then discuss it," says Jones and goes his way.

Smith, in the library, consults a code book and writes his initial on a slip, together with the ['code word' for the topic] and "recents," and passes it in at the desk. The attendant [keys it in and returns with] a strip of photographic paper. On it appear a dozen items. One of these reads: "217,384, Phys. Rev. Oct. '36, P. 483, Osborne, U. M. 3846, Precise Examination of a Series of stripped Atoms, methods of exciting double ionized lithium, Electrodeless discharge. should be checked and, if found operative, will supersede prior methods. KSJ."

Much of this is self-explanatory. The first number is the serial number of the item, so that it can be readily found if Professor Jones should later order it amplified or cancelled. The U. M. gives the location where the author, Osborne, performed the experiment. The 3846 is the shelf number in the library where the Journal is to be found. Then follows the title of the article, and finally Jones' comments of six months before and his initials. Here are placed before Smith all the pertinent references within articles, on the specific matter of inquiry, with critical comments by experts in the field. Smith has saved a week's hunt, and he has all there is to be had.

The multiple intelligence of the reviewers whose judgments are stored for the use of others is the king-pin of the machine. To the individual reviewer, then, the machine will offer a new opportunity for usefulness, a consequent new dignity. More immediately, what will it mean to him? Many things, of which these so soon can be clearly foreseen: The peace of mind which comes of being able to have a judgment on the literature of his subject recorded quickly and accurately, stored safely, recalled instantly; the accession of energy for other things which comes of this freedom; the sharpening of thinking which comes of the corroboration of his judgment, or the criticism of it, by fellow reviewers in his field; the increase of effectiveness and efficiency which comes of the foregoing values; the widening of his range of thinking and acting which comes, to the reviewer as well as to the student, through familiarity with and use of the service offered by the device. If he is a teacher, he will be able to transmit to students his thoughts in specific, not general terms. If he is a researcher, he will be able to communicate to his colleagues his judgment by direct, not slow and unwieldy means. The machine will thus, whatever his main activity, implement him to perform his work more readily and more fully, and so will help him in transcending the limits which his physical self places upon his intellectual effectiveness.

— A Reference Selector

Vannevar Bush, 1937

It consists of a desk, and while it can presumably be operated from a distance, it is primarily the piece of furniture at which he works. On the top are slanting translucent screens, on which material can be projected for convenient reading. There is a keyboard, and sets of buttons and levers. Otherwise it looks like an ordinary desk.

...Thus he goes building a trail of many items. Occasionally he inserts a comment of his own...

And his trails do not fade.

— As We May Think

Question: Has any digital-computer system responded to questions phrased in ordinary English, or other natural language, by giving correct answers in natural language?

Requested bibliographies will be available at about 18:00. Do you want them delivered, or will you call, or will you request typeout?

Unfortunately, my office is not located near a pneumatic tube station.

Refer to bibliographies I requested last Friday.

Do cited or related references contain explicit definitions of "syntax", "syntactics", or "semantic"?

— Libraries of the Future

In essence, this new model is based on the social construction of knowledge...

... focus is now upon computer support for the conversation of knowledgeable peers—the social content of the interface is predominant;

— The Society of Text

I am in cyberspace. I once again resort to a freer writing, a writing more fluid and random....

Every paragraph an idea, every idea an image, every image an index, indices strung together along dimensions of my choosing, and I travel through them, sometimes with them, sometimes across them....

...Like a bird of prey my acuity allows me to glide high above the plains of information, seeking jewels among the grains, seeking knowledge.

I sense the presence of others. I see the traces of passage, the flares of trajectories of other searches. Those who share my interests visit the spaces around me often... I open channels and request communication. They blossom into identities that flow in liquid metamorphosis.

— Cyberspace: First Steps

...when we design computer media we are hardwiring a mechanism for the social construction of knowledge.

...Ten years from now our old card catalog may well have metamorphosed into a "virtual library" of its own. It should be possible to "browse" the stacks without leaving the terminal; to "open" a book and view its table of contents; perhaps even, to flip through the pages of two books, physically located on different levels of the stacks and compare them.

— Sociomedia

The computer textualizes everything: it is our writing of the world as we know it, a map of illiteracy. It must always contain a black space, a margin in which to write...

... empowerment may be just as important a goal as simplicity for many users.

— Contextual Media

The Philosophy Behind the Project

The Continuity Project is a Manifestation of the Invisible College

Centered on and named by the philosopher, physicist, and chemist Robert Boyle (famous for Boyle's Law), *The Invisible College* was an informal learned society in seventeenth century England. It began meeting circa 1645 at about the same time that the mathematician John Wallis organized a similar group to meet at *Gresham College* . Even after these groups went on to change history by formalizing their efforts in the founding of England's legendary *Royal Society* on November 28, 1660, the concept of an informal invisible college held a powerful allure. It was again manifest in the eighteenth century when the *Lunar Society of Birmingham* was constituted to promote the study of the practical arts pioneered by the *Dissenting Academies* among the middle classes. The modern conception of the Invisible College as something of a collective conscious embodied in interpersonal correspondence of the academic community originated quite recently when science historian Derek J. de Solla Price (1922-1983) published his magna opus *Little Science, Big Science* in 1963, in which he argued that distributed groups of scientists working on common problems constitute invisible colleges to offer encouragement, confer status, and "solve the communication crisis by reducing a large group to a small select one".

The idea of an invisible college has taken on new currency with the explosive growth of the Internet, which, with its dedicated mailing lists and e-journals, is literally saving the art of scholarly communication from extinction as skyrocketing subscription costs consume ever greater percentages of our libraries budgets crippling their ability to keep pace with the expansion of the record.

In a sense Price's focus was too narrow, for it is not enough to think in terms of supporting individual discourse communities which are arguably well served by our current generation of Internet technologies and the marked increase in specialization that characterizes on-line scholarship. Unfortunately, this environment is not particularly friendly to the lay researcher, the undergraduate students, the uninitiated, and the boundary spanners struggling to bridge the gaps between the disciplines and maintain the continuity of the larger academic community; for to them, the Invisible College remains, for the most part, invisible!

Yet, historically our greatest strides have been made by those individuals who freely slipped the bounds of disciple avoiding the calcification of thought that comes with too narrow a focus.

The Continuity Project is a manifestation of this long tradition that strives to extend it to embrace these unmet needs, to model and cast light on the discourse communities that dedicate themselves to the pursuit and transmission of knowledge. It is this tradition of the amateurs, mentors, educators, boundary spanners, and life-long multi-disciplinary and inter-disciplinary contributors that the *Invisible College* represents and which this project hopes to empower!

As we set forth to develop the ***Continuity*** software, we embrace the pedagogical principles of Seymour Papert's Constructionist model which holds that *people learn best while creating personally meaningful artifacts!*

It is our hope that the various facilities developed for ***Continuity*** will possess this quality and that, in working on a large scale real world project that must of its very nature knit together many strands of research, our students may escape the lack-of-experience Catch-22 that plagues recent graduates.

We are confident that the undergraduates and graduates working on the project will come to internalize a holistic view of the academic enterprise and build a rich set of shared skills and individual core competencies that will enable them to make significant high-impact contributions over the full course of their lifetimes.[9]

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[9] The reader concerned with such pedagogical issues in the context of science and innovation is commended to see *Discovering : Inventing and Solving Problems at the Frontiers of Scientific Knowledge* by Robert Scott Root-Bernstein. Harvard, 1989. If your interest goes more to the use of technology to facilitate education, see *Engines for Education* at <http://www.ils.nwu.edu/~e_for_e/> by Roger C. Schank and Chip Cleary. The Institute for the Learning Sciences, 1994. The former work is also a rich source of insight in the development of a general research ontology. The later, while ostensibly focused at the K-12 level, serves as a functioning example of an ASK system that also touches on the problem of "inert" knowledge at <http://www.ils.nwu.edu/~e_for_e/nodes/NODE-19-pg.html>.
The ILS Technical Report series at <http://techreport.ils.nwu.edu/> is a veritable gold mine of ideas for case-based reasoning and computer aided instruction. Reports #2 and #25 bear particular attention.

The Need and Prospects for the Project

Current library catalogs don't reflect how people really work with information, making them very inefficient tools, particularly for users new to a discipline. They represent monolithic centralized efforts to structure access to the written record that are failing to adequately address the growth of that record or to tightly integrate newer forms of scholarly communication (e.g. the web). Attempts to address the later of these concerns tend to focus on indexing newer media under traditional print classification systems (e.g. the Cyberstacks(sm)[10] project at Iowa State University) or on converting traditional print sources into a digital form (e.g. the Cornell Digital Library project). Several projects have developed testbed platforms succeeding to varying degrees in integrating sundry commercial and public domain tools to achieve these goals.[11]

Universal scanning and indexing is not enough.

But even if every book were digitized, if every web page were assigned an LC call number, and if every catalog record in the world were available on the desktop, this approach would still have failed to address the more pressing issues of providing a fine enough granularity to the indices, protecting the user from information overload, and supporting the naive user's efforts to embrace a new field of knowledge. Indeed such a system would prove even less useful than current ones (even if we assume the presence of full text searching and some heuristics to reduce the number of records presented to a more manageable number than the millions that could well be returned in response to any query) because our underlying approach to cataloging doesn't capture the often subjective and uncertain domain specific *directory knowledge* that guides real researchers.

Granted that any future catalog ought to employ Natural Language Processing techniques and Infometric Analysis which could probably extract some of this from the raw text of encoded documents. However, as a discipline matures it evolves a conceptual schema and historical gloss that writers assume they share with their audience, thus in many cases the most critical meta-content simply cannot be found in or inferred from the text itself!

Lessons from Law

It is to the world of law that one must turn for a glimpse at what should be commoñ place. For in law, effective information retrieval is the cornerstone of juris prudence, the doctrine of stare decisis demands that we reconcile our decisions with similar past cases leading to much more explicit attribution of ideas within our literature. Opinions are scrupulously indexed by proprietary topical "key numbers" and the intent of bibliographic references is loosely captured by Shepard's Citations such that one can readily find cases that explain, distinguish, or follow a given one.

With this bounty of raw data, it is little wonder that law has been such a rich source for bibliometric research. More generalized citation databases were introduced in the 1970's to cover broader areas of scholarly periodicals, but as Professor Geraldene Walker has observed they lack authority control and often contain inconsistencies, propagating errors from the original journal's copy.

Keeping Pace with the Growth of the Record

This leads us back to the dilemma facing any centralized indexing or authority control enterprise. While it may be convenient for libraries to subscribe to the services of such bibliographic utilities they can't hope to keep up with the explosion of self-published scholarship on the web, offer variable grained indices to meet the needs of experts as well as novices, and perform the back work to eradicate all vestiges of uncertainty.

While their are many domain specific controlled vocabularies and thesauri that can do much to ameliorate the granularity problem within a discipline, they have traditionally been prepared for the library professional and are seldom integrated into the end-user experience; moreover, they tend to be highly context sensitive making any effort to serve a broad constituency of discourse communities quite daunting. Only a large scale distributed solution will do and only through such a means can we reasonably hope to capture the "modals" — intentional relationships akin to the distinctions reflecting the purpose of citations that make legal information retrieval effective.

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[10] <http://www.public.iastate.edu/~CYBERSTACKS/>

[11] We must note however that current initiatives have been subject to criticism for too great an emphasis on building technology testbeds at the expense of content /collection development and user/usage studies. By providing an extensible architecture — in short a software framework for dynamically adding and evaluating new search and retrieval strategies, Continuity will allow multiple experiments to leverage off a common knowledge base making it possible to compare and contrast approaches while providing an unprecedented level of user feedback.

The Invisible Web

Law has long strived to capture the gestalt recognizing that individual works do not stand alone and since legal outcomes effect powerful interests there has been no shortage of funds to maintain the intensive centralized efforts needed to maintain the meta-record. Once we move outside of this unique context the economics change and one cannot hope to significantly expand the role of the bibliographic utilities which already strain the budgets of their subscribers.

Facilitating the Research Process

Let us now pause to consider how real researchers work. Over the years I have spent much of my time on interdisciplinary research, entering new fields of knowledge and new bodies of literature with considerable regularity. The library catalog is of limited utility at these times. I may turn to an encyclopedia for some background and to identify potential subject terms, but unlike legal encyclopedias, general reference works make no serious effort to key one into the literature. Still, they give you enough to plug in some search terms and find the area of the stacks in which that subject is housed.

Unfortunately the linear arrangement of shelf spaces will frequently put relevant material out of reach displacing material on a topic like Schank's **conceptual dependency theory** so it will not be found with general artificial intelligence work where one might expect it. Thus if one didn't know about it in advance it might never be found. Short of stuffing index cards into books or publishing a survey article, there is no mechanism by which I might alert other scholars to this peculiarity of organization.

Augmenting the Record

Suppose now that a naive user arrives at my public library and randomly picks up a gardening or cookbook. He or she might find an old recipe calling for the use of an herb, such as Comfrey (*Symphytum officinale Boraginaceae*), which some authorities no longer deem safe for internal consumption. Again, short of defacing the book or having it removed from the shelves depriving everyone of access to the rest of its content, there is no way to address this issue

There is no way for me to find out what books are valued in the new discipline short of asking a human or falling back to the old grad student strategy of "reading around" at random for some weeks on the assumption that I will chance on enough evidence to form an accurate opinion. I can't consult the catalog and determine which sources are most popular. I can't find out at a glance which works have been discredited or which contribute to the most lively debate. I can't directly learn anything of substance about the authors in a field or the issues that concern it. I can't even find any guidance in deciding whom I might want to talk to in person to seek guidance.

In short, I can't work efficiently since little of the information I would seek from an expert is captured in the traditional catalog which is organized around physical sources instead of the people, places, objects, issues, ideas, and dialogues they concern. Everything is reduced to a handful of subjects and descriptors that capture none of the nuance and texture behind them.

Implications for the University

The University has institutionalized amnesia as semester after semester students repeat the same background research forming opinions and making observations that are lost to the world unless their work is deemed specialized and advanced enough to warrant formal publication. This is not to say that they ought not master such research skills, merely that their efforts ought to contribute something of lasting value on which the next scholar who passes their way might build.

Clearly there is need for a shared core of readings, but some significant measure of effort should be channeled where it is not reduplicative of earlier work. One ought not have to await a Ph.D. to take part in the dialog — an issue must be addressed in any solution to our dissatisfaction with the conventional catalog.

Conclusions

Throwing hoards of professional indexers at the information explosion may not prove to be economically tenable or generate qualitatively acceptable results in the long run, nor will imaging and OCR'ing the entire corpus of print resources for centralized storage, nor will any other technique applied **in isolation**. By creating an extensible integrated framework that puts **end users** at the core of its strategy, we can shift paradigms and make the dynamics of change work for us!

But if we close our eyes and carry on along our present course, the Library and to a lesser degree much of Academia itself, will come to be seen as increasingly irrelevant in the face of a web-based

free for all as the window of potential funding for new information infrastructures closes and purely commercial considerations come to dictate the shape of future information access. How ironic it would be if we failed to fully unlock the benefits of technologies we have so long nurtured with public support at the very point when their potential to transform our libraries, universities, governments, and corporations for the benefit of all was at its greatest!

Across the nation a whole generation of scholars is being lost to underemployment, downsizing, and a pervasive lack of opportunity that stems from the loss of self-confidence throughout our great institutions. This new lost generation has great potential and much to offer. Given the opportunity and modest support, it stands ready to take up the challenge and join with government and industry to create a truly innovative information infrastructure for the future that will finally unleash the missing productivity gains which we have so long sought from our information technology investments.

Future Directions

The time is ripe to move forward. In March of this year Daniel E. Atknis of The University of Michigan's School of Information & the Department of Electrical Engineering and Computer Science organized a *National Science Foundation Planning Workshop on Distributed Knowledge Work Environments : Digital Libraries* in Santa Fe, New Mexico. The purpose of the workshop was to evaluate the results to date as the initial period of funding for digital library research under the NSF / DARPA / NASA Digital Library Initiative (DLI) draws to a close.[12]

Those initial projects took, for the most part, a high budget narrow domain imaging intensive tack and lead the workshop to these conclusions expressed in the Abstract of its final report:

> Some desirable distinctions between the current DLI and future programs include the following: Current DLI, involves broad technical agendas, experimental, technology testbeds, modest support for content & collections, narrowly circumscribed context of evaluation, and few user/usage studies. Suggestions for future initiatives should, by contrast, have refined technical agendas, real-world testbeds emphasizing interoperability and integration, increased support for content and collections, operational systems containing collections of value to domain applications, broad, multidimensional contexts of evaluation, and user/usage-oriented focus. Some participants further stressed the need for more emphasis on the applications of digital libraries. This was proposed in order to build user support for digital libraries, to deliver value to teachers and scholars in different contexts, to link up with the commercial publishing world, and to focus research in the most valuable directions.
>
> There was general agreement over the days of the workshop that any new initiative should be structured to encompass a "diversified portfolio" of research, embracing small and large, highly specific and highly general research trajectories. These would call for strategically structured funding initiatives involving cooperative contracts and grants with the various partners suggested in the previous section.

In light of these considerations, it should be clear that The Continuity Project would be an ideal candidate for funding in the second round of the NSF / DARPA / NASA Digital Library Initiative. Our unique mix of user-centric design and our planned end-user programming capabilities would make our proposal particularly intriguing to these agencies.

By making it easy to incrementally adapt Continuity to changing conditions we will move away from the current monolithic model in which institutions completely replace their OPAC roughly once every five years, with a model based on continual evolutionary improvements and extensive customization at the departments, work group, and individual levels.

Our plans for the Epoch extension language and framework will allow our proposal to offer an alternative to the troubling trend of pressuring programmers to standardize on a common programming language.[13] In essence, the purpose of Epoch is to compliment Java by providing a range of server-side programming options and CASE tools making it feasible for different research groups to integrate their results.

Therefore we are confident that, *The Continuity Project* will be able to attract strong corporate, government, and institutional support!

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[12] While we still await receipt of the full hard copy report, the Workshop's web site - - can be found at <http://www.si.umich.edu/SantaFe/>.

[13] This move, primarily towards Java, is driven by the desire for "write once, run anywhere" code based on *byte-code interpreters* which emulate the effect of running the code on a common architecture neutral *virtual machine*. This introduces a significant performance penalty unless the *virtual machine code* is compiled down to *native code*. Michael Franz and Thomas Kistler of the University of California at Irvine offer a more elegant tree-based approach to portability called *Slim Binaries* which is used by the *Juice* browser plug-in.

Desiderata

Continuity will be a New Millennium OPAC Designed to Function as a User-Centric Collaborative Knowledge-based Learning System

The catalog needs to provide its users with a grounding in fields that are new to them. It should offer both visualizations of the collection and of scholarly activity using the collection. It should support subjective queries and be able to handle a natural language dialog. Over time it should develop personal profiles of its users and tailor its responses to better meet their needs. It should help them to get into contact with one another and to update the overall store of knowledge to manage errata and incomplete leads.

To achieve these objectives, Continuity needs to capture far more meta-knowledge about its subject matter than one ever found in a three-by-five card file, and the only feasible way to build such a store of knowledge is to gather it in small measures over time from a large number of users.

But if we want our end users to contribute this knowledge, we must solicit it as transparently as possible. Our ultimate end users simply cannot be expected to sit at a terminal for a prolonged period, book in hand, keying in answers to questions from the catalog.[14]

Moreover, the system must scale up economically to support more users and domains of knowledge and it must be extensible over time so that it can integrate new technologies, new media, and new data types along with new domain specific control heuristics.

Taken together with the foregoing desiderata, these considerations lead to our ultimate design goals. Thus in its ultimate form, Continuity must provide:

An Extensible

It should have at its highest levels, an object oriented systems architecture to promote well factored extensibility. It should expose an application programmers interface and provide network access protocols to support low level third party extensions and cooperation with remote processes. It should have (and provide hooks to develop additional) interfaces to view and manipulate HTML, HDF, and other raw data formats. It should provide a mechanism to refine the ontologies used by its subsystems to better support the unique aspects of key domains like Law. It should be programmable at a high level by its *end users* in a *multiparadigm programming / scripting language* to encourage the development of new facilities to seamlessly augment the capabilities of the base system.

Intelligent

The system needs to be able to respond to natural language queries, both to support user access with low-end hardware and to provide an alternative to the direct manipulation paradigm in controlling visualizations. It should have plan recognition capabilities and maintain user profiles so it can resolve ambiguities, handle ellipsis, and most importantly, base its recommendations on the needs of individual users. It should support some form of *non-monotonic authority control* so it can capture, recover from, and work with incomplete (or even erroneous) citations. It needs a heuristic basis to provide context sensitive evaluations of the credibility and utility of individual sources and authorities. It should offer a scalable adaptive user interface and provide extensive context-sensitive help to minimize training and support costs.

Integrated

It must provide a uniform interface to print and digital resources. It should unify the library catalog with the campus-wide information system. It needs to support and combine both graphical and textual modes of interaction with its users. It should also incorporate models of people, organizations, concepts, and artifacts. Since the system must be extensible, it must support *computer programs* as a key class of artifacts and should therefore support their direct invocation through the system (see Licklider's *Libraries of the Future*). Recognizing the importance of such programs, both as a means of augmenting the system's capabilities and of conveying substantive knowledge, a *literate programming* — and more generally, by logical extension a *literate note-taking* — environment should be provided to produce both highly readable documentation/notes and executable code/knowledge-base entries as an integral part of its architecture. In short, the system must provide a complete information infrastructure that facilitates research, analysis, and publication.

[14] However it is reasonable to have them provide such feedback on a sporadic basis and for us to engage in a concerted centralized effort to seed our initial system with coverage of project related literature.

Collaborative Catalog

The system should rely on a broad spectrum of objective and subjective input from its users to refine and extend its knowledge over time.[15] System-wide security protocols, including provision of *statistical database security*, must be implemented to guarantee *user control* of access to their personal profiles and borrowing patterns on a fine grained basis (eg. a user might elect to make public all borrowing and comments not related to some sensitive topic like "personal retirement planning" research). It should employ a *cybernetic* design with *social control heuristics* to encourage cooperative behavior, guide its future growth, and optimize the utility of its resource allocations. It should provide a mechanism to route and retain questions and recommendations for future research. It should offer a variable grain of coverage to reflect the needs and interests of its user community (ie. some areas may contain little more than current catalogs while others will have fully developed subject outlines, video ASK systems to introduce and evaluate resources, and extensive ongoing critical discussions). It should directly support user-user interaction with directory services and interactive communication facilities with optional anonymity. It should be pro-active and directly initiate queries of recognized experts as one of its information seeking strategies as well as suggest possible collaboration between researchers exhibiting similar interests.

& Distributed

This is implicit in our need to support personal computer, work station, and personal digital assistant based satellite systems for transparent personal use in note-taking and *information farming*[16] through which the system can learn. By pre-clustering the collection into various subject matter domains and storing them on separate departmental servers, it will be possible to exploit the parallelism inherent in our organization of the record to deliver faster response times and prune the search tree to offer more contextually sensitive help. A distributed architecture will also scale more readily and offer performance that gracefully degrades under increased system loads and an expanding user base. Moreover, by avoiding the need to store all of the systems knowledge in a centralized store we can significantly increase the forty odd gigabytes of storage employed by current systems without facing a cost prohibitive investment in new high-end computer hardware.

Institutional Memory Archive

It should be structured as a heterarchy of nodes representing and preserving the intellectual activities of entire organizations, departments, workgroups, projects, and individuals. It should retain compressed archival records of all substantive transactions (ie. those containing opinions, evaluations, theories, and suggestions) at each level for subsequent use. It should even record erroneous hypotheses, incomplete citations, hunches, and possible leads, all of which can prove to be of significant value. It must offer sophisticated filtering capabilities and employ heuristic search algorithms to make this bounty accessible. Finally, in should directly model and offer visualizations of the use of the collection itself with which we may optimize resource allocations and gain substantive insights into the growth and direction of entire disciplines!

The preceding analysis, which we continue to refine, embodies our design goals for The Continuity Project. During the course of its development we will progressively phase in greater levels of functionality over time until the lines between our research prototypes and the evolving production system eventually dissolve.

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[15] See "Pattie Maes on Software Agents : Humanizing the Global Computer", *IEEE Internet Computing*, Vol. I, No. 4, July/August 1997 in which Professor Maes posits that instead of taking a centralized approach to knowledge base development (as has been the case in the Cyc and Ontolinua projects), one would do better to "have a system that asks anyone who's online at the moment", p. 14.

[16] See <http://www.eastgate.com/squirrel/FAQ.html#Theory>

A Scenario

Like Vannevar Bush's Reference Selector and Memex, J.C.R. Licklider's Procog, Douglas Engelbart's Augment/NLS, Ted Nelson's Xanadu, Daniel Rose's SCALIR, and Stuart Sutton's LEX, Continuity represents a break with our current assumptions and mental models about how we should structure our interaction with the written record.

It builds on a rich tradition dating back to the 1930's and represents over a decade of the Director's interdisciplinary research into Law and AI, Human-Computer Interaction, Computer Science, Information Science, Innovation Management, Technology Transfer, and Law, Technology, & Management.

Here then is a typical scenario illustrating some of the capabilities of the system:

It begins with a student, manager, or government worker being presented with some new issues to research. He or she turns to an ubiquitous terminal and logs in, entering a name for the new project and thus establishing a unique context for subsequent dialog. If it is part of some larger initiative this is readily indicated either graphically or through a brief remark. The system then displays a quick 3-D fly through of high level subject areas much like we find in the HotSauce application.

When the user gets to the general neighborhood of the problem, the users slows down and additional display options become active. Since this is a new problem and an unfamiliar area, the user hits a help key and enters a video-based ASK system in which an expert provides a quick grounding in the field, explaining the main issues in the area, indicating major schools of thought, some leading thinkers, etc. Clicking on one of the issues leads to a second clip that offers some literature guides. The user types in a request for the most recent general survey work that is respected by his or her department but that doesn't rely on much math. Two books are cited, but one is in use. The system doesn't know if either uses much math in its treatment but offers to ask the books' last borrowers if it does. An hour later, the system reports that the older book does and the newer one doesn't. This information is now added to each book's record.

The next day the user visits the library and borrows the most recent book, takes it out to the park and curls up under a tree with it and his or her Personal Digital Assistant. The small screen is well organized for loosely structured note taking and it only takes a couple of taps to indicate which phrases represent ideas, people, places, projects, and things. In the next half hour the main ideas from the book have been captured and a half dozen literature references, some incomplete, have been noted.

At this point the user sets the book aside and initiates a radio-LAN link to Continuity and the notes are up-linked to his or her account. Continuity then presents the full records for several of the references and offers its heuristic assessment of which of several alternate titles the ambiguous ones represent.

Our researcher had noted that one of these sources was criticized for inaccuracy in the general work and taps a verify button on the PDA causing Continuity to flag that source as being in question. As it turns out, that very source is on loan to a professor, who is trusted by Continuity as an authority with knowledge in the field. From the faculty lounge, the professor responds to Continuity's query by confirming that the source is in fact accurate, at which point Continuity flags the general reference work as being wrong on this point and suspect in its literature evaluations.

Meanwhile, since the professor has some free time, she offers to assist the researcher who brought the issue up; thus Continuity establishes a chat session between them in the top half of the researcher's PDA. In the bottom half the researcher takes some more notes for later use.

Returning home at the end of the day, our intrepid knowledge worker links the PDA to a personal desktop copy of Continuity which then organizes, cross-references, and prints out a neat copy of the notes while uploading some subjective feedback along with an anonymous user profile to the central system for future reference. As the sun begins to set, Continuity informs the researcher that an essay he or she had contributed anonymously to the system had attracted the interest of an alumnus recruiter who would like to talk to its author. After a brief anonymous discussion, actual identities are exchanged leading to a new job offer.

Most of the underlying research to realize the foregoing scenario has already been completed and countless efforts are underway to refine individual techniques which might be applied in such an environment. Continuity will draw on work in AI, Natural Language Processing and Agent based technology coming out of MIT, information retrieval work at Xerox PARC, insights drawn from Douglas Lenat and R.V. Guha's work on the Cyc project, Roger C. Schank's efforts to design ASK systems at the Institute for the Learning Sciences, the innovations of the Hyper-G Consortium, Dave Winer's ingenious contributions with Frontier, and the host of digital library efforts now underway. Unfortunately the record has been mixed in terms of integrating these technologies and transferring them from the lab to the field.

A Simulated User Session

Continuity will be a full participant in an evolving multi-modal dialog with its users!

Although Continuity is envisioned as an **integrated** system that will make extensive use of visualization technologies, much of its functionality will be exposed through a natural language dialog facility that will provide accessibility to remote or visually impaired users connecting via a conventional Telnet interface. Moreover, even in its graphical form, the Continuity interface will employ a mixture of modalities in which dynamic visualizations will influence the course of a running natural language dialog which will in turn permit a finer grain of control of the visualization at a higher level of abstraction than could be supported by a direct graphic manipulation metaphor alone.

This superimposition of textual and graphical dialogs will likely prove to be of particular value in the effective navigation of the n-dimensional "Benediktine Space" that could be generated from the Continuity knowledge base. To get a better sense of the uses the system might make of visualization techniques, please take some time to review the projects highlighted in the Big Picture(sm): Visual Browsing in Web and non-Web Databases clearinghouse maintained by Gerry McKiernan and Peter J. Wasilko, Esq. They also offer a more general survey of New Age OPAC's in the Onion Patch(sm): New Age Public Access Systems.

Before reading our simulated Continuity user session, please consider these desiderata set forth by Nicholas Negroponte, founder of The Media Laboratory at MIT, in his 1970 opus, *The Architecture Machine: Towards A More Human Environment*, which remains remarkably compelling and illuminating to this day.

> Imagine a machine that can follow your design methodology and at the same time discern and assimilate your conversational idiosyncrasies. This same machine, after observing your behavior, could build a predictive model of your conversational performance. Such a machine could then reinforce the dialog by using the predictive model to respond to you in a manner that is in rhythm with your personal behavior and conversational idiosyncrasies. (p 11-13)
>
> ---
>
> (1) mutual interruptability for man and for machine, (2) local and dedicated computing power within the terminal, and (3) a machine intelligence. (p 23)
>
> ---
>
> ...The dialog will evolve an intelligence, this intelligence will stimulate a more profound dialog, which in turn will promote further intelligence, and so on. (p 25)
>
> **— The Architecture Machine**

Entering Text Access Mode

Continuity

An Extensible Intelligent Integrated Collaborative Catalog and Distributed Institutional Memory Archive

The Library of the Future that Never Was, Realized in the Sociomedia of Today!

==========

Please insert your university ID / Smart Card, activate your PDA's Infrared "Continuity Connection" tool, enter your name, or hit <return> for anonymous guest access:

>

Card 2 9089000492207 recognized.... Continuity Established!

==========

Welcome back, Peter. It's a few minutes past 5 in the afternoon of September 26th, 1997.

You are currently working on the following projects:

1. Looking for clustering algorithms in procedural languages.

2. Finding out more about J.C.R. Licklider.

3. Reading up on natural language processing in Prolog.

You can begin a new project at any time.

>2

Restoring the context of project 2.

I have found 2 more references to J.C.R. Licklider in the periodical literature.

But, before we continue, another user has a question that I cannot answer. Could you help?

> Why me?

Your colleague has asked me for the definition of a term that is not yet defined in the Word Net 1.5 lexicon; however, it does appear in the context of several works you have read.

> What is it?

The term is "procognitive" in the phrase *procognitive systems*, which appears in several notes about J.C.R. Licklider's work.

A morphological analysis suggests a literal meaning of "systems for knowledge" or "systems in support of thought".

Can you define the expression for me with respect to its use by Licklider in terms suitable to a novice.

> Licklider defines procognitive as literally meaning "for knowledge". Procognitive systems are computer systems designed to promote the development and consolidation of knowledge by groups of people working on loosely related research.

Where would one find more information about "procognitive systems"?

> in his "Libraries of the Future"

Two definitions added to main dictionary; citations to J.C.R. Licklider and his book, *Libraries of the Future* , noted in the idiom entry for *procognitive systems*.

Definition for procognitive submitted to the Word Net group presuming an "extremely rare" familiarity.

Your assistance is appreciated and will be considered when you make priority requests.

> What other items did Lick write?

Do you want me to use Lick as an abbreviation for J.C.R. Licklider?

> Y

Did J.C.R. Licklider use Lick as an alias, or have other writers used it as such?

> ?

If he used it as an alias or if other writers did, I can add that information to his profile. Was this the case?

> Yes, he insisted that everyone call him that.

Alias "Lick" established for J.C.R. Licklider because "he insisted that everyone call him that."

In answer to your previous query, Lick wrote:

"Man-Computer Symbiosis" and "The Computer as a Communication Device" with Robert W. Taylor

> Who is Taylor?

Director of the Digital Equipment Corporation 's Systems Research Center - dates unknown.

> Cross-reference Lick and Taylor.

That may take a few minutes.

==========

Done.

Taylor wrote the preface to "In Memoriam: J.C.R. Licklider 1915-1990" --- Digital Systems Research Center: Report 61.

==========

Its abstract reads:

==========

August 7, 1990

In the 1960s, J.C.R. Licklider published his ideas about the future role of multiaccess interactive computing. He looked beyond the existing limitations of punched cards and paper tape to a time when computers would interact in real time with the human user. By performing numerous routine tasks on demand, computers could contribute to a person's ability to formulate new insights and decisions. He saw man-computer interaction as enhancing both the quality and efficiency of human problem solving.

Articulating his vision was an important contribution in challenging people to examine the implications of an emerging technology. But through his work for the "Advanced Research Projects Agency" (ARPA), he was also able to give his vision reality. The projects sponsored by his program provided the research direction for computer science in this country for many subsequent years. Furthermore, his program was the first to provide the significant public funding necessary to guarantee the financial stability on which long-term research depended.

Perhaps his most important influence, however, was in the area of computer science education. Prior to his work at ARPA, there were no departments in US universities offering a Ph.D. in computer science. His program sponsored research at four of the first universities to offer graduate computer science degrees. These departments in turn provided role models for other departments that followed.

J.C.R. Licklider thus played a central role in initiating and sustaining computer science research and education in this country. To commemorate his important contributions, we reprint here two of his papers, "Man-Computer Symbiosis" and "The Computer as a Communication Device." In recognition of the debt owed to him by the whole computer science profession, and by every user of interactive computing, we dedicate this report in his memory.

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> Do we have it?

No, but this report can be downloaded in Postscript or PDF format, or it can be ordered free of charge via e-mail from "src-report@src.dec.com".

Since you generally prefer pre-printed hard copy, would you like me to order that report for you?

> Y

e-mail dispatched.

> All done!

See you next time, Peter. Have a nice day.

We Can Build It

To create a viable system it is vital that it be designed to run on readily available hardware, use the best available technology to minimize the need to re-invent the wheel, and be tightly integrated with the user interface of its host system to make its operation as intuitive and transparent as possible. Continuity must be designed to run on a high end Internet/Intranet server and also operate on the desktop[17] to help users visualize, organize, and analyze their personal research efforts. But since few users are willing or able to conduct all of their research in front of their desktop system, Continuity must eventually run in a stripped down form on a handheld device to provide integrated semi-structured note-taking any time and any where!

MCF (Meta-Content Format), as modified by R. V. Guha at Netscape to work with eXtensible Markup Language (XML), and MIT's FramerD have the potential to replace MARC (MAchine Readable Catalog) records which suffer from confounding issues of logical data format, physical representation, content, and coding to such a degree that an early treatise on MARC format recognition required one hundred and fifty pages and an additional twelve appendices to explain; indeed the current scheme is so baroque that the 1988 based text with supplements through the end of 1991 confront the would be system designer with three and one-half inches of specifications and content designation guidelines. HotSauce suggests new visualization paradigms for citation networks and the cross-platform QuickTime Media Layer used in conjunction with Java or Juice offers the most practical medium for building the video-based ASK system to introduce new users to unfamiliar disciplines.

An interdisciplinary team in a university with strong external ties has the best potential to put all of these pieces together. The best approach would be to create something of a high-tech startup environment rather than a multi-institutional multi-group mega-project like the University of Michigan Digital Library for which Apple has been supplying hardware. The **core group** should be small enough (not more than a dozen) to have a realistic chance to forge a consensus and develop a shared vision. The WSU Software Practicum offers a sterling example of our intended methodology and pedagogical approach.

[17] Continuity Servers might be restricted to POSIX compliant OS's and rely on Java to provide a uniform user interface on PC's, inexpensive NC's which would serve ubiquitous terminals, Java enabled PDA's for personal note-taking, and Java-based SmartCards which would serve as active Campus ID's allowing each user to access a personal workspace from any device connected to the system.

Over the first semester during which the group's primary focus would be a comprehensive literature survey. During the same period we would begin some exploratory programming while formalizing the system architecture for Continuity, both in terms of communication protocols and MCF/XML extensions to support a generic research model. On a PDA we would begin to develop the semi-structured note-taking application and catalog client (most likely in Java unless native development tools proved superior). On the desktop we would begin to develop or adapt the database server process and start to code import export modules to load MARC and Bibtex records. Soon afterward we would implement the ASK system with a team assigned to capturing expertise from retiring faculty members and building the first domain specific interactive essays. In parallel, another team would be introducing the first version of the collaborative system allowing users to annotate bibliographic records in the database and submit subjective ratings of sources. We would begin to use the system to manage our own research as soon as it came on line and in the second year these prototypes would be introduced to target user populations. As we note in the next section, it is impossible to accurately assess time tables for the project, but our guiding philosophy will be to start simple with an extensible framework and deploy that internally at the first opportunity, grafting on additional functionality in phases over time so the system could begin to learn about and model the collection at the earliest possible date.

Once a working prototype is ready, it would be introduced to smaller target groups for actual use in their research until the system became sufficiently stable and had acquired enough domain knowledge to be offered as an auxiliary catalog to the overall community. The personal memory component would probably be offered at an earlier date to anyone using supported hardware so our user base and catalog could grow from the ground up, allowing us to catch any problems with scalability early on.

If Continuity fulfills its promise, its host university would stand to gain a tremendous measure of prestige propelling it to a preeminent position among its peers. For the students participating in the project, it would serve as a springboard for promising new careers.

The software and its development framework could of course be licensed out to produce a revenue stream, either through individual sales of a shrink-wrapped product or through institutional licenses under a model similar to that used by the Project Mandarin Consortium.

The Director

Peter J. Wasilko, Esq.

J.D.,LL.M.

Project Director & Principal Investigator

My academic pursuits have long been characterized by a high level of interdisciplinary work in which I found our current library catalogs woefully inadequate while paradoxically using them to discover just how much progress was being made in state-of-the-art research systems to which they bore little resemblance. I think this observation was the core motivation that led me to concentrate in Law, Technology, and Management at Syracuse University College of Law. It also had the effect of sensitizing me to how we explicitly model information and conduct research in law. Thus when I had the opportunity to work with Professor Stuart Allen Sutton of the School of Information Studies, while researching potential applications of a ground breaking inference engine for Syracuse University's *Technology Transfer Research Center*, I became enthralled with his Ph.D. Dissertation on "*Managing Legal Information: A Model of Institutional Memory Based on User Cognitive Maps*". This opened up a whole new body of literature to me at about the same time that I was experimenting with an early beta of Storyspace that the University was testing in one of its labs.

After graduating with my J.D. and LL.M. I was finally free of mandated assignments and able to focus more intensely on integrating the assorted strands of research that I had had to keep on the back burner. I started looking more at semi-structured hypertext systems and met with some of the developers of NoteCards at AAAI '93 & IAAI '93 in Washington, D.C.

By that point I had found that the earlier works of a field often provided a better entry point to the literature of a discipline than more current ones, with Ashby's "Introduction to Cybernetics", Nicholas Negroponte's "Architecture Machine" books, Marvin Minsky's survey of "Semantic Information Processing", and of course J.C.R. Licklider's seminal "Libraries of the Future" serving to best illustrate this heuristic!

Of course, one also must look to current efforts. The Web has proved indispensable in this regard, giving me access to the latest on-going research. Yet in exploring digital library project after project, what I saw, with few narrowly targeted exceptions, were primarily efforts aimed at computerizing the conventional library, which wonderful as they are in promising the day on which every page in the world will be imaged and accessible on my desktop, fall critically short in helping one to manage their bounty. In this regard I would contend that we are rapidly approaching a major cataloging crisis, which we can only hope to avert by questioning our fundamental assumptions about who should catalog, what should be included in our catalogs, and how the library as an institution should fit into a world increasingly dominated by an unrefereed explosion of countless sources.

And yet, as I have delved ever deeper into the record, looking at how we came to this state of affairs, I have found an untraveled fork in the road, a path not taken dating back to Vannevar Bush's unpublished speculation on "A Reference Selector" in 1937 (a key excerpt of which I have included in the inspiration page of this site). That most remarkable exposition embodies the earliest seeds of the ideas presented herein. Had Bush remained active and pressed forward with this vision, perhaps as an active participant in Project Intrex with J.C.R. Licklider, we might live in a very different world today. And yet "after the war years rather completely knocked [him] out of all things [he] had been trying to do, [he] never did go back into [library research]. (see. V. Bush, *Draft of Talk for Woods Hole Conference*, 1 August 1965)

In any case, these grand old men of science would be the first to defer to my generation to carry forth the program they so boldly outlined. Unfortunately, the times have not been kind to my contemporaries and there are those who no longer feel that we can embark on such projects without decades of working experience and formal investiture in the status quo. But we can take heart in the writings of giants like Bush and Licklider who would without question offer different council.

In their day the technology to create the systems they envisioned was still in its infancy. Today we can refine that vision and finally make it a reality. To my mind, we need an **Extensible Intelligent Integrated Collaborative Catalog & Distributed Institutional Memory Archive**. We have the technology and the talent. The costs for such a initiative would be negligible compared to a "brick and mortar" capital project but an investment in the **"human capital"** to create an **information infrastructure for the future** would offer tremendous potential returns.

The only real question that remains is : **Do we have the will?**

— Peter J. Wasilko, Esq.

The Project Advisory Board

In order to ensure that Continuity embodies the best practices and has the depth and breadth to serve as an open ended platform ready to receive tomorrow's discoveries, we are setting up a Project Advisory Board of leading outside experts with backgrounds in the core technologies we are hoping to integrate into the project. They have volunteered to review our progress and offer pointers to resources, options, and contacts which might otherwise elude us.

Our Initial Board Members are:

- **Gerry McKiernan**, A.B., M.S. — Curator of the Cyberstacks(sm) at Iowa State University

Gerry is a key player in the establishment of clearinghouses to facilitate the development of new millennium library catalog systems.

- **Mark Bernstein** — Chief Scientist at Eastgate Systems, Inc.

Mark is enjoying a remarkable career developing serious Hypertext software while playing an active role in many scholarly conferences.

- **Susan Thomas,** Ph.D. — Syracuse University School of Management, 1997

Susan's research and teaching centers on Innovation Management, New Product Development, and Creation Setting.

- **Steven J. McCaffrey, B.S.** — Computer Science and Applied Mathematics, University at Albany, 1986

Steve is an independent scholar, programmer, and technology accessibility advocate for the disabled.

If you would be interested in joining the Advisory Board, do feel free to contact our Project Director, Peter J. Wasilko, Esq.

We are always looking for new opportunities to collaborate with our peers and would therefore welcome any research pointers, leads to possible host sites and project sponsors, or opportunities to help you integrate your own research into the project's framework so we might better leverage our resources.

We especially welcome inquiries from graduates and advanced undergraduates who might like to volunteer to participate in the implementation of various Continuity subsystems either as part of their academic programs or as an extracurricular activity to enhance their résumés.

11/97 Addendum

Our newest board member is :

Ron Kalinoski, M.S., The University of New Mexico — Coordinator of the Distributed Staff Program, Software Assets Manager, & Listserv Manager, Syracuse University Computing and Media Services.

With his 17 years at SU in such positions as Associate Director of Research Computing and Director of Faculty Computing, Ron offers a unique perspective on technology adoption, usage, and end-user support.

Managing The Project

> *...most existing measurement systems seem inherently unsuitable because of the uncertain nature of research and development and because they ignore the vital role of the individual who supplies the estimates of required and achieved progress. Fundamental to the design of effective controls for a research and development project is the recognition that much accompanying bias, noise, and random elements often mask the real progress that is taking place.*
>
> **— *Dynamics of Research and Development***
>
> **Edward B. Roberts , 1964**

In discussing The Continuity Project with potential hosts and sponsors, questions of time tables and related planning issues frequently arise. Indeed, with the advent of powerful project management software to automate the rigors of their application, academic and corporate technology managers have become increasingly sophisticated in their use of project management techniques.[18]

The Limits of Project Management

Thus it is quite natural to expect every initiative to be commenced by developing a detailed work breakdown structure, Gantt chart, and PERT chart extrapolating detailed time and resource allocation predictions from an analysis of the project's Critical Path[19]. And yet despite the widespread use of these techniques projects continue to come in overdue and over budget.

While there are many diverse causes which contribute to this disappointing state of affairs, we can venture to identify several of them. First, the constraint propagation networks employed in the Critical Path Method are only as accurate as time estimates entered by project managers.

Thus when a new project is undertaken which embodies standardized tasks or otherwise familiar patterns of activity, one can estimate task durations with the high degree of accuracy necessary to derive the maximum benefit from the Critical Path Method. Conversely, if a new project is composed of unfamiliar tasks or dynamic patterns of activity, one can not reasonably place a high level of confidence in ones estimates of how long various tasks will take (and even what tasks will have to be undertaken for that matter), making it highly unlikely that the timeframe and critical path(s) derived from traditional project management techniques will have much more accuracy than those derived through informal methods.

The Limitations of Project Management Software

Moreover, one must recognize several major shortcoming in the project management software itself.

First, most programs assume a level of confidence in one's numbers that simply is not justified under most circumstances. As errors in such estimates are inevitably introduced, they are carried forward in time by the software, accumulating in wildly inaccurate results.

Project Managers can attempt to compensate for this by formally introducing *slack time* into the project that can later be used to offset delays so they don't have an impact on the projects long term schedule. Another useful technique is to introduce greater levels of parallelism into the project's structure to eliminate unnecessary inter-task dependencies; this helps to control error propagation and to further reduce the impact of delays upon the project. However, if a number of paths of roughly equal duration are pursued in parallel to achieve a project's ultimate objective, it may become extremely difficult to accurately identify a single critical path. In short, as one increases the parallelisms of a project one reduces *large scale* completion date errors at the cost of loosing precision in the identification of critical tasks.

Second, the tools assume that the workflow of a project can be captured by a *directed acyclic graph (DAG)* which is a set of *nodes* or *vertices* (i.e. points in this context representing tasks and milestones) connected by a set of *arcs* or *edges* which can only be traversed in one direction (i.e. lines capturing a partial sequential ordering of task dependencies; partial in that a link between tasks can have associated *lag* value(s) allowing the next job's start and finish to be set in relation to those of its predecessor), which are arranged so that no *path* can lead back to a node through which it passes (i.e. their is no notion of *control* which would permit looping through a sequence of steps repeatedly until some condition is met).

Since software development tends to follow just such a pattern, project managers have been forced to

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[18] See *Project Management : Strategic Design and Implementation* by David I. Cleland. Tab Books, 1990 for a traditional exploration of these issues.

[19] i.e. the sequence of critical tasks whose latest completion deadlines cannot be missed without causing the overall project's deadline to be missed.

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compromise by either merging any such cyclic structures into a single task and guessing at their combined duration without any support from their project management software package, or more commonly, by repeating the same sequence of tasks in-line often hiding their details in multiple identical *subprojects*.

Yet such work-arounds are still not satisfactory since they still force one to estimate in advance the number of times such a sequence will be repeated. This makes it impossible to answer a question like *"How many times can we revise and review our documentation and still meet the deadline?"* without having to create and experiment with multiple versions of a project. Since each alternative must be represented in the software by a different structure simply altering task durations is not enough.

Future Directions

Indeed, the inability of these packages to *reason in the alternative* makes them far poorer tools for exploring *what if* scenarios than one might expect from prior experience working with spreadsheets, with which they share many underlying concepts. This discussion suggests several directions worthy of pursuit. Borrowing from AI work on "problem decomposition" future project management tools could incorporate *AND/OR graphs*[20] (which offer both a data structure and convenient graphic notation system) so that project managers could directly model within a single project alternative strategies (i.e. alternative project structures could be merged in a single AND/OR graph).

Fuzzy Logic could be utilized to replace specific estimates or even estimated ranges with *fuzzy values* along a continuum from say "very short" to "extremely long", which if combined with the ability to directly model *iterative* tasks would lead to something analogous to a *fuzzy cognitive map*[21].

An interesting alternative was explored by Edward B. Roberts in his fascinating 1964 work, Dynamics of Research and Development in which he used *simulation* techniques to model the R&D process itself thus anticipating later efforts by Peter M. Senge whose modern classics *The Fifth Discipline: The Arts & Practice of the Learning Organization* and its sequel *The Fifth Discipline Fieldbook : Strategies and Tools for Building A Learning Organization*[22] argue for a similar systems theoretic approach to planning!

Ironically, the underlying discrete event simulation technologies[23] have fallen somewhat out of favor, in general management curriculi in recent years while gaining new currency in Computer Science and AI work on Artificial Life[24] and Software Agents[25].

> There is considerable uncertainty as to the outcome of an R and D program, the uncertainty being, of course, closely related to the degree of knowledge in the relevant fields and to the advance sought in the programs. Attempts to develop an object that represents a marked advance in the state-of-the-art are subject to great uncertainty; attempts to improve an existing object are subject to relatively little uncertainty.
>
> **– *RAND Research Memorandum, RM-2146***
>
> **Richard R. Nelson, 1958[26]**

We Can Manage the Risk Inherent In The Project

Nevertheless, we should not let the foregoing analysis of the applicability of current project management techniques dissuade us from our task.

To begin with, we must recognize that traditional project management techniques were never designed for use in a small high-technology start-up environment. They work best in static *production oriented* settings with highly standardized tasks, be they in manufacturing or transaction processing, where budgets are high, deadlines paramount, and *resources* (i.e. personnel and equipment) are completely fungible. In such environments, the manager of a "plant opening" or "file conversion" can develop enough accuracy in estimating task durations for the critical path analysis and resource leveling (i.e. automatic identification and re-assignment of overworked or underutilized personnel and equipment) can produce dramatic reductions in cost and time.

For The Continuity Project *in the large*, these assumptions do not hold. The Project is small and highly innovative. Since we can not make time estimates with any degree of accuracy, the use of PERT Charts and the like to create the appearance of hard

[20] See *Formal Concepts in Artificial Intelligence* by Rajjan Shinghal. Chapman & Hall, 1992.

[21] Bart Kosko has written extensively in this area and any of his works may well be consulted for background.

[22] Doubleday 1990 and 1994 respectively.

[23] See *Introduction to Simulation Modeling Using GPSS/PC* by James A. Chimsman. Prentice Hall, 1992.

[24] See *Artificial Life : The Quest for a New Creation* by Steven Levy. Pantheon Books, 1992.

[25] See *Software Agents*, Edited by Jeffrey M. Bradshaw MIT Press 1997.

[26] "Invention, Research, and Development: A Survey of the Literature," *U.S. Airforce Project RAND Research Memorandum, RM-2146* Richard R. Nelson, 1958, as quoted in *The Dynamics of Research and Development*.

schedules would at best be unjustified and at worst border on deception of our potential hosts and sponsors.

A Technology Fusion Strategy!

To date, Peter J. Wasilko, the Project Director and Principal Investigator, in consultation with the voluntary Project Advisory Board, is conducting all of the planning, host and sponsor negotiation, background research, user interface design, knowledge base compilation, software development, and web site management for the Project.

All of these initiatives are proceeding in parallel and are beginning to produce a steady stream of deliverables as evidenced by the continual evolution of our web site and the forthcoming debut of the Stone Soup clearinghouse, which may well pave the way for a New Catalog Consortium.

In any case, by drawing on the work of Stone Soup participants it will be possible to follow a Technology Fusion[27] strategy and incorporate entire subsystems and infrastructures from external partners leaving us free to focus on technology integration and to leverage research results from the last thirty years to produce a truly unique and powerful library of the future.

Thus even in the absence of formal project management, we can create a Learning Organization[28] with Probing Teams[29] that will be highly responsive, generate a series of constantly evolving prototypes, and move forward honestly with all deliberate haste.

This is not to say that there will not be subprojects within The Continuity Project for which such techniques would not be applicable. However, they will likely arise during later phases of the project as we address issues of *Grant Administration* and move towards actual *System Deployment* — activities for which our host institution and sponsors will be able to provide benchmark time lines.

Finances

In budgetary terms, The Continuity Project should be treated as an on-going initiative or center for excellence without a fixed termination date. While the Project will thus be open ended, we can still proceed in an economical fashion, by drawing on the work of our colleagues and by forging strategic alliances with industry to maximize external support and minimize our expenses. To this end we, as we have perviously indicated, are beginning to contemplate the possible formation of a New Catalog Consortium with a structure roughly analogous to that of The Open Group[30] which maintains the X Window System.

In short, we are very flexible and could start on a shoestring within an existing department or center and grow into a full fledged quasi-independent research and development entity supporting multiple projects, initiatives, students, and faculty. By that point it would likely follow the pattern set by the Institute for the Learning Sciences sponsored by Andersen Consulting at Northwestern University and the Cyc Project emerging from the Microelectronics and Computer Technology Corporation (MCC) by forming a commercial spin off in a local Research Park[31] to market the ultimate fruits of the project to organizations which had not directly participated in their development.

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[27] See *Emerging Patters of Innovation : Sources of Japan's Technological Edge* by Fumio Kodama. Harvard Business School Press, 1991.

[28] See Senge.

[29] "Outward Bound: Strategies for Team Survival in an Organization" by Deborah Gladstein Ancona of MIT in the *Academy of Management Journal* 1990, VOL 33, No. 2, 334-365.

[30] The Open Group has an example consortium participation contract at <http://wwopengroup.org/tech/desktop/x/xptagree.htm>. Under this X Project arrangement firms and academic institutions wishing to participate in shaping the X Window standard contribute $5,000 annually to become Review Members, $10,000 to participate in defining the Reference Platform, $25,000 to receive voting rights in the X Standard Focus Team as a Specification Member dealing with the software standard and/or $25,000 to join The X Technology Focus Team as a Technology Member dealing with the hardware standard (i.e. $50,000 to participate in both teams). • Counsel looking for more general treatment of technology licensing agreements are directed to *Technology Management : Law/Tactics/Forms* by Robert Goldscheider. Clark Boardman, 1991. • Technology managers will find a brief treatment of R&D Consortia along with many related topics in *Strategic Technology Management : Systems for Products and Processes* by David I. Cleland and Karen M. Bursic. American Management Association, 1991.

[31] Anyone interested in the design and development of R&D Parks should consult Technology in the Garden : Parks and Regional Economic Development by Michael I. Luger & Harve A. Goldstein. The University of North Carolina Press, 1991. Interestingly, the provision of value added, knowledge & expertise access assistance like that which would be provided by Continuity has been shown to have a measured impact on the success of such parks, since start-ups are particularly sensitive to difficulties in finding people and information, which is why informal regional support structures are so critical. By automating and mediating access to such resources, Continuity would help attract park tenants and increase their chances to prosper.

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Common Concerns

Since, people new to The Continuity Project, tend to raise the same issues of concern, we would like to dispense with them here, in part to highlight some of the key elements of our planning.

Q. Aren't there established commercial players, like the companies already marketing OPAC's and the many great search engine providers on the web, who have market inertia working in their favor that are doing the same things you are talking about?

A. No, these players already are quite comfortable in their own niche markets and have no economic incentive to undertake the effort involved in trying to integrate access to print and digital sources, let alone to try and incorporate all of the advanced technologies contemplated herein. By opening a significant after market in system enhancements to anyone with the requisite technical skills, the provision of an end-user extensible system like Continuity might be seen as a threat to the revenue streams they derive from periodic system updates and proprietary technical implementations. On a more basic level, Continuity in its initial stages of development will be predicated on a level of trust that more closely approximates that present in an academic community than the net at large. Moreover there are a great many variables and parameters in the design and operation of the system that must be explored before it will be suitable for wide-scale commercial use. As **lead users** of libraries, IT systems, and *augmentation research* as Engelbart would describe the field, the scholar/developers of The Continuity Project, with the support of their industry partners, will be in the best position to explore this problem space and develop a marketable design (see Eric von Hippel's *Sources of Innovation*).

Q. What about current digital library research, isn't it developing the kind of system you are talking about?

A. No, most of the digital library projects now underway are focused on the problem of imaging entire works and/or converting them to textual representations. They are generally concerned with the digital preservation and distribution of books under a traditional model of library function. We have no desire to replicate this work which is very hardware and funding intensive. Some smaller projects are doing exciting things with visualization and automatic indexing with *Kohonen Self-Organizing Maps* or other novel technologies, but by and large these are ad hoc efforts in dire need of integration. Thus Continuity stands out as offering a holistic solution to our evolving needs.

Q. You talk a lot about the system learning from its users, but distributed trust has left the Internet rife with miss-information; what if the users make serious mistakes or worse?

A. This is nearly as much of a problem with conventional print sources, although the errors often tend to be less dramatic than those propagated through the net. Fortunately, Continuity will have far more meta-information available to it than conventional catalogs which will make it possible for users or, by default, the system, to choose among heuristic filtering algorithms to gage the credibility of available sources and users. By tagging incoming information with its source, the system will be able to identify malicious actors. A system of *distributed trust* in the PGP sense whereby users make independent judgments about the expertise and trust worthiness of trust worthiness assessments of other users can further bolster the system's ability to cope with uncertainty. Of course, it should still be possible to maintain a verified centralized knowledge base for a sizeable set of core materials (essentially those records imported from established bibliographic utilities augmented by trusted faculty contributions).

Q. You've said the system will be extensible by end users and have authoring capabilities, how can I maintain reasonable security, administer the system, and avoid loosing control of IT policy if we deploy it?

A. You are quite right in your perception that Continuity could have a powerful decentralizing influence which your organization may not give you the latitude to permit. Therefore, we will design the system to be **IT Policy Neutral** so it can be readily configured to support whatever administrative constraints you need to impose. All contribution will be tagged with their origin which can optionally be made visible to end users or restricted to administrative personnel to provide users with some measure of anonymity. Provision will also be made for truly anonymous access, tagged as such so you can block any contributions so made from having immediate effects, if you wish to enable it. Security and administrative decisions can be made globally, or propagated through an organizational hierarchy (say with each department or team free to adjust certain parameters, or override them with regard to internally generated content), as a matter of academic freedom individuals will have the freedom to restrict access to their own research and modify their own personal workspace to augment its functionality, though the later capability need not be supported by your help desk staff which could simply instruct any frustrated

users to "revert" to the default settings if their explorations didn't work out. (Also note that processes executing within the system would be subject to resource constraints so an errant process would not "crash" everything.) In addition to such fine grained security and policy controls, Continuity will embody a unique **micro-preference** system as part of its social control heuristics which in conjunction with *PGP-style distributed trust* can be optionally used to automate some security, budgeting, and collection development decisions. As a result of these design decisions, you can expect to see considerably greater control (if you wish to exercise it) under Continuity than would have been possible with its predecessors. You will be able to customize policy to meet the needs of each distinct group of users within your organization or you could take a hands-off approach and let the cybernetics of the system play out in an unrestricted fashion while monitoring their development with the high-level summary displays the system will provide.

Q. If my institution were to host the project, would it see an **Immediate Return on Investment**?

A. We can understand such bottom-line concerns and are regret that they have become an unavoidable facet of academic life. Fortunately we can answer with a qualified **yes**. For, although it would not be realistic to expect to see a fully functional system in the near term, we could begin to develop useful stand alone components from the outset which might, for example, serve to enhance your campus-wide information system. The system's PDA-based personal note-taking software which would be developed during a later phase of the project would probably present an excellent opportunity for commercialization, particularly if we target a professional domain like Law for its initial application. Still, if your budget is tight these and subsequent benefits derived from the increase in scholarly productivity that would be possible through use of the system may sound too nebulous to you, in which case, we ask you to consider the fund raising and technological leadership potential inherent in creating a new information infrastructure which could be leveraged to attract grants and personnel, improve your institution's ranking, and inspire your alumni body to increase its support. Moreover, and perhaps most significantly, from day one, the project would provide its participants with immediate real world experience like that offered by the WSU Software Practicum to dramatically increase their placement prospects.

Q. My support budget is already badly strained and a good number of our students and faculty don't make full use of the technology we already have (some are still running old versions of DOS); how could we possibly afford the training and support costs of something like Continuity?

A. High training and support costs are symptomatic of badly designed systems that don't accurately model how their users work. Such systems often automate rather than aid and are tacitly designed to insure an after market in training and support services, while locking customers into their platform with assurances of backward compatibility. So effective is this strategy that it is now more common than not for the better technical solution to fail in the marketplace. After all, it takes considerable courage to risk depreciating the value of one's own expertise by introducing a simpler system. But over time the negatives of bad design weigh down even the most entrenched of legacy systems opening a window of opportunity for significant change. We feel that this is such a time in the evolution of OPAC's and that with a prudent well factored design and interface we can introduce significant improvements in functionality while minimizing transition costs to acceptable levels. For the most part the system itself would provide full training in its use. Moreover, by offering a scalable adaptive user interface it could directly meet the needs of users with widely different skill levels.

Q. Would I have to invest in all new hardware to use the system?

A. No, we could provide both world wide web and telnet based interfaces allowing access with even the most archaic of hardware so one could even use an ancient ADM or Volker Craig dumb terminal to interact with the natural language interface. Of course to fully access some of the more advanced features it would be desirable to phase in the use of NC's with color monitors and higher speed communications links. Likewise, while the personal note-taking software would only make sense for users of what are now considered higher end Personal Digital Assistants retailing for close to one thousand dollars, the team charged with "priming" the system during its initial deployment could make due with a small number of shared units. Over time, as Moore's Law drives down prices, it is reasonable to believe that such systems will be widely adopted by faculty and students either on their own initiative or as part of overall plans to create a campus-wide wireless network now that the FCC has paved the way in opening spectrum for such use. Indeed, it is now predicted that wireless networking "cards" will be available for such devices by year end.

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Q. Do you have any of this technology working yet?

A. To date, The Continuity Project has restricted its efforts to research and planning pursuant to finding a host institution. At this point we are poised to begin work on implementation; however until a host site is chosen and appropriate sponsorship secured, we can't determine what resources we will have at our disposal. Thus it would be ill advised to begin intensive programming efforts when even the most basic of the attendant design decisions like choice of supported platforms or development environments would have significant lasting repercussions. Thus, until we have a home, it is critical that we maintain as much flexibility as possible so that when we do commence active development we can make the best use of the most current technologies available to us at that point.

Therefore, we are stressing cross-platform solutions and programming language design issues in our research. As far as the specific technologies alluded to in these pages, we are happy to report that most are well documented in the literature, have been successfully implemented by other teams, and could be readily integrated into a suitable extensible environment such as that envisioned herein. Indeed some of the "new" technologies we plan to incorporate were first demonstrated in the 1970's.

That said, we are beginning to do some exploratory programming with a mix of languages and OS's. We will be using Prolog for our early *natural language processing* and machine *translation work*. Perl is better suited to experiments in importing and converting MARC records. FramerD Script under Windows95 offers a promising environment for our distributed knowledge base. Java lends itself to cross-platfrom user interface development. Finally, Common Lisp or Scheme will likely serve for our programming language design platform. We are also looking at several alternative POSIX compliant server OS's including the Be OS which will be available for PowerPC and Intel hardware.

Q. Wouldn't pursuing The Continuity Project require an expensive, cost prohibitive, long term commitment?

A. Just as Continuity is structured to be scalable, so to is The Continuity Project itself. We could easily structure the initiative as an extended clinic, practicum, or honors seminar under the rubric of existing course offerings, run it as a major departmental project or semi-autonomous interdisciplinary research program, or expand it to serve as the nucleus of a full fledged *Center for Technology Integration*. In time it might even be spun off into a commercial venture retaining close ties to the university and generating an appreciable royalty stream for its parent institution. In any case, a formal position needs to be created for the Director whose research and energies form the core of the project, preferably in the form of a tenure track, junior faculty position with cross-appointment to the participating academic units. As soon as a provision is made for the Director, which is seen by potential sponsors as a sine-qua-non of demonstrating host buy-in, it will be possible to begin assembling external funding and technical support with which to fund the staff & work-study programming and research positions through which development can proceed at full pace. Thus at minimum, your initial outlay would be for one multi-year junior faculty position through which external funding would likely be attracted to fund additional slots. Once we begin work, you can expect a series of high profile deliverables (technical reports at first, followed by useful software components, and eventually a home-grown replacement library catalog). Along the way, we should be able to establish collaborations with other research groups through which they might elect to port their own technologies to function within the Continuity framework, which could significantly accelerate our development timetable. One could then look to Linux as a model for the subsequent evolution of the system.

Q. Why should my organization host or invest in Continuity?

A. The Continuity Project has the potential to fundamentally change how learning organizations like Universities, Law Firms, Corporations, and Governments cope with the explosion of information that characterizes our age. It builds on a long tradition of research and carries forward the unfulfilled plans of some of the greatest minds of twentieth century — scholars like Bush and Licklider who shaped the world we now live in.

Continuity can unlock the latent productive gains that we have yet to realize from our IT investments. It will generate spin-off products, help its participants launch their careers, and provide countless benefits to its host institution and sponsors.

If there are any issues that you would like us to address in this space, don't hesitate to contact us.

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The Project on the Web

Visit our web site at :

http://www.cloud9.net/~futurist/continuity/

This document roughly corresponds to the Background section of our project web site, which will be brought into full conformance with these pages in the weeks ahead. After that point, any materials superceeding this document will be so marked on the site's index pages.

Readers interested in a partial but growing listing of the hundreds of references with which we are working are directed to the References section of our web site.

Our Research Notes expand on some of the References cited above to offer abstracts and context representative of kind of meta-content we wish to embody in the Continuity.

Our Field Notes go beyond these written materials to embrace various lectures, conferences, and trade shows attended by the Director.

Our Design Notes offer simulated screen shots of our Graphic User Interface Designs and attendant discussion of human factors related issues.

Our Tech Notes now offer an overview of our design goals and initial development plans for the Epoch language and extension framework.

In the coming months we will be adding more resources to the web including materials suitable for faculty use.

If you would like to be notified of significant changes to the site, feel free to email the Director.

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New York State Bar — ***Admitted to Practice*** 1993

Membership

American Bar Association
New York State Bar Association
NYSBA Law Office Economics & Management Committee
Phi Alpha Delta Law Fraternity International
American Association for Artificial Intelligence
AI and the Law & ***AI in Business*** Subgroups

Education

Syracuse University College of Law ..... Syracuse, New York

Law, Technology, And Management Certificate ..... May 1997

Master of Law in Taxation and Technology ..... May 1992

Juris Doctor ..... May 1991

Awards

Recipient of the ***College of Law Award*** for the highest achievement in *The Regulation of Electronic Mass Communications*.

Activities

Business Law Society
Communications Law Society
Entertainment Law Society
International Law Society

State University of New York at Albany ..... Albany, New York

Bachelor of Arts — magna cum laude in Political Science; minor in History ..... May 1988

Experience

Intern, ***Technology Transfer Research Center*** ..... Syracuse, New York (9/91 - 5/92)

Worked in interdisciplinary teams to evaluate technologies and to make recommendations for their future commercialization, development, licensing, and protection based on an analysis of key legal, technical, and marketing considerations.

Pupil, ***Leonard Woodley, QC*** ..... London, England (6/89 - 7/89)

Assisted Barrister Alan Williams and others in the Chambers of the Middle Temple in trial preparation, correlation of evidence, review of files, and analysis of jury reaction during several major trials.

Special Skills

- New York State Notary Public: Qualified in Westchester County.
- Completion of the ***Law, Technology, And Management Program*** with University-wide work and the study of Communications, Computer, Contract, Entertainment, Intellectual Property, International Business Transactions, and Technology Transfer Law.
- Study of Organizational Learning, New Product Development, and New Venture Management with the ***Innovation Management Program*** in Syracuse University's ***School of Management***.
- Study of the Information Processing Industry, Project Management, Information Retrieval Technology, and Institutional Memory with faculty of Syracuse University's ***School of Information Studies***.
- Advanced study of ***Taxation*** encompassing Corporate and Personal Taxation, Tax Accounting, Tax Procedure, and Tax Policy.
- Proficiency in on-line legal research and information retrieval using ***Internet, Lexis/Nexis, Westlaw, and Dialog Services***; in the use of Project Management, Relational Database, Desktop Publishing, Spreadsheet, Hypertext, and Word Processing packages; and in working with PC's, Workstations, and Mainframes from a variety of manufacturers.
- Field work researching Internet-based Computer Crime leading to expertise in security matters.
- Study of Computer Mediated Communication (CMC) and Computer Supported Cooperative Work (CSCW).
- Extensive use of Syracuse University's ***Advanced Graphics Research Laboratory & Virtual Reality Lab*** and text-based virtual reality simulations like ***The MIT Media Lab's MediaMOO*** a professional on-line virtual community of media researchers.
- Familiarity with exploratory data analysis; programming language and user interface design; computer programming in Forth, APL/J, Pascal, C/C++, LISP, Scheme, Dylan, Perl, Java, and Prolog; and the use of artificial intelligence techniques for expert systems, problem solving, information retrieval, and natural language processing.
- See "The Continuity Project — An Extensible Intelligent Integrated Collaborative Catalog and Distributed Institutional Memory Archive" at <http://www.cloud9.net/~futurist/continuity/> for an extended sample of my writings and ongoing research.